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**Bailey et al.**

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(54) **INFLATABLE SIDE AIRBAG CURTAIN MODULE**

(56) **References Cited**

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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This patent is subject to a terminal disclaimer.

(57) **ABSTRACT**

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A side impact or rollover protection restraint system (20) comprising: an air bag of sufficient length to extend between two pillars of a vehicle, the air bag (22), upon inflation, is of sufficient height to extend from proximate a roof rail (38) of the vehicle to a location generally adjacent the upper torso of a seated occupant such that the inflated air bag will lie between the occupant and a side portion of the vehicle; the system (20) further including a flexible tube (70) having a plurality of distributed openings (72) thereacross to distribute inflation gas to the air bag means (60) for inflating the air bag.

**Related U.S. Application Data**

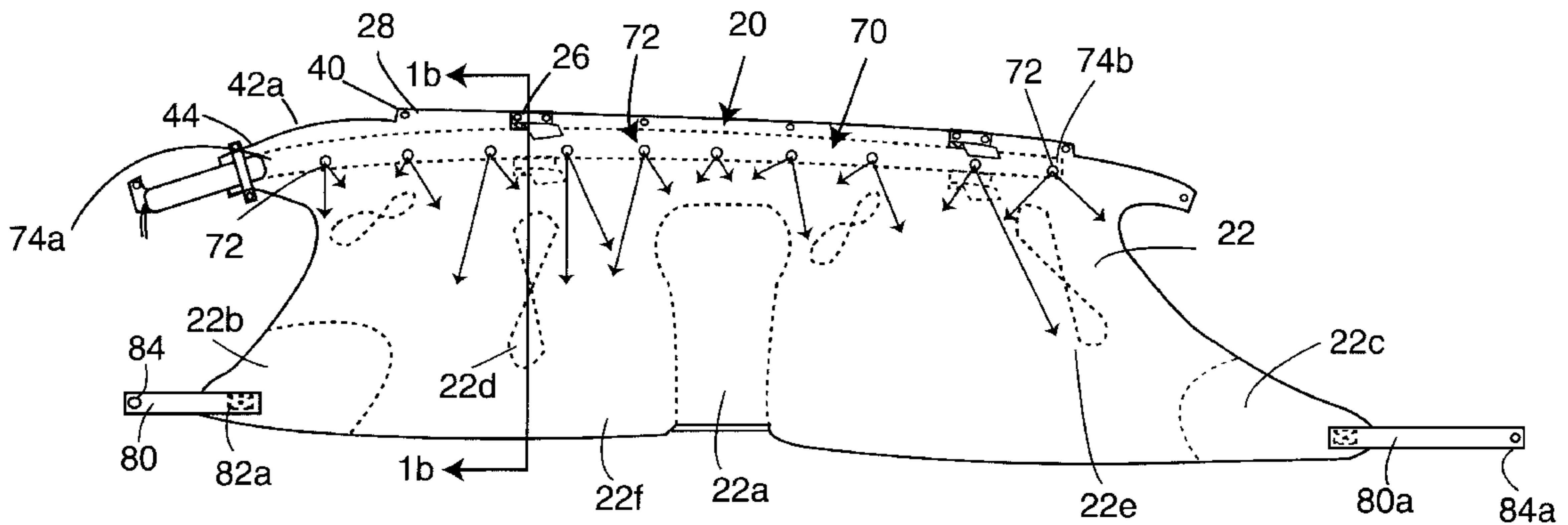
(62) Division of application No. 09/026,571, filed on Feb. 20, 1998, now Pat. No. 6,073,961.

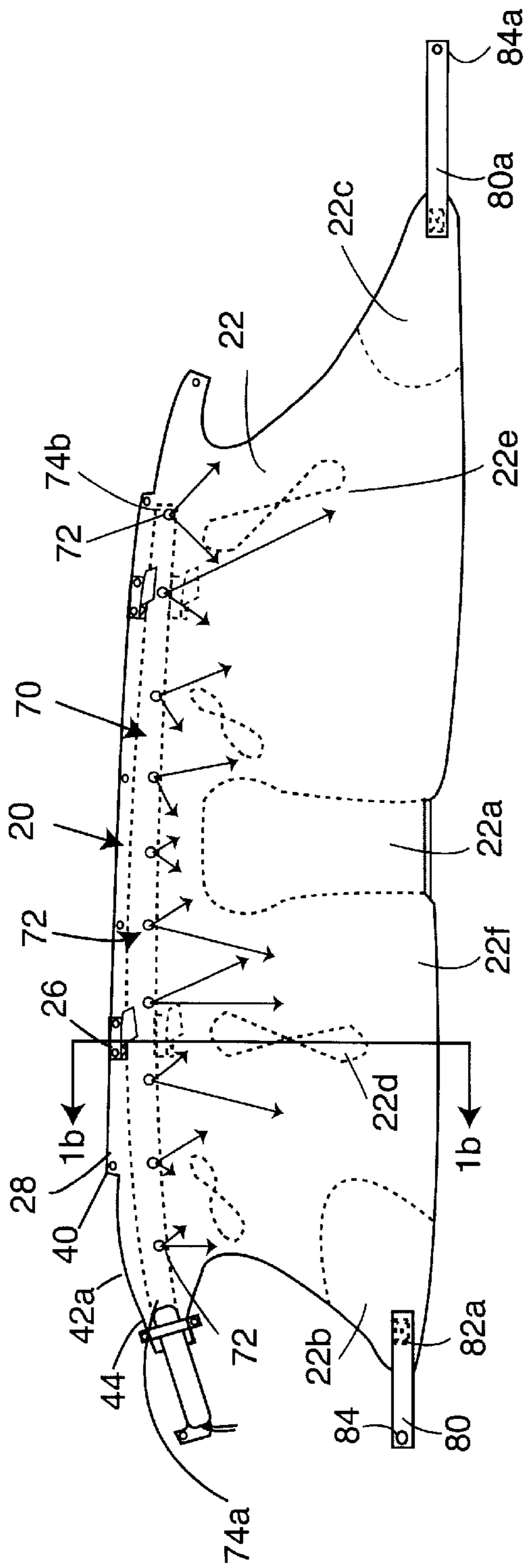
(51) **Int. Cl.**<sup>7</sup> ..... **B60R 21/22**

(52) **U.S. Cl.** ..... **280/730.2; 280/729**

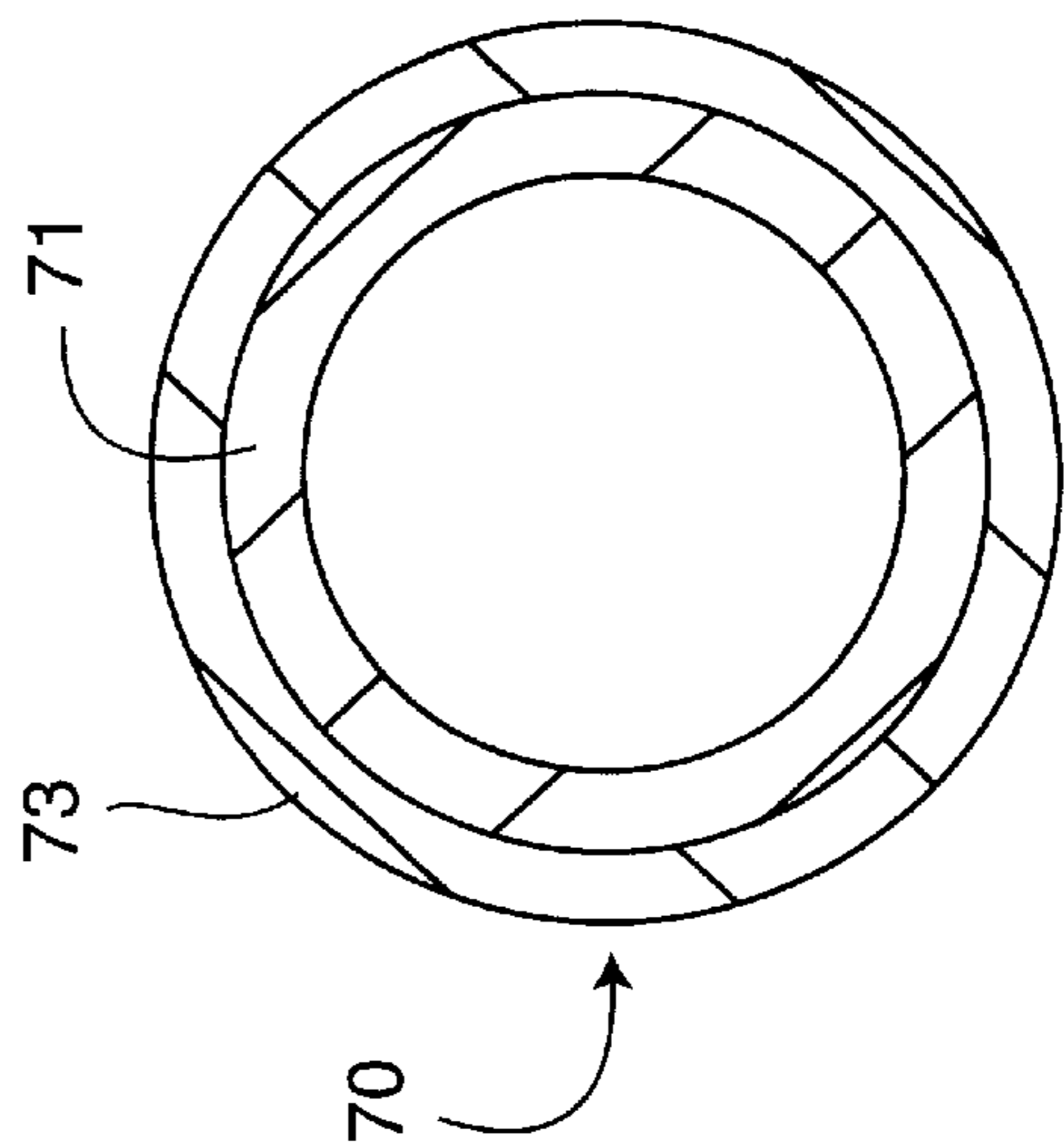
(58) **Field of Search** ..... **280/729, 730.1, 280/730.2, 749, 743.1**

**14 Claims, 7 Drawing Sheets**

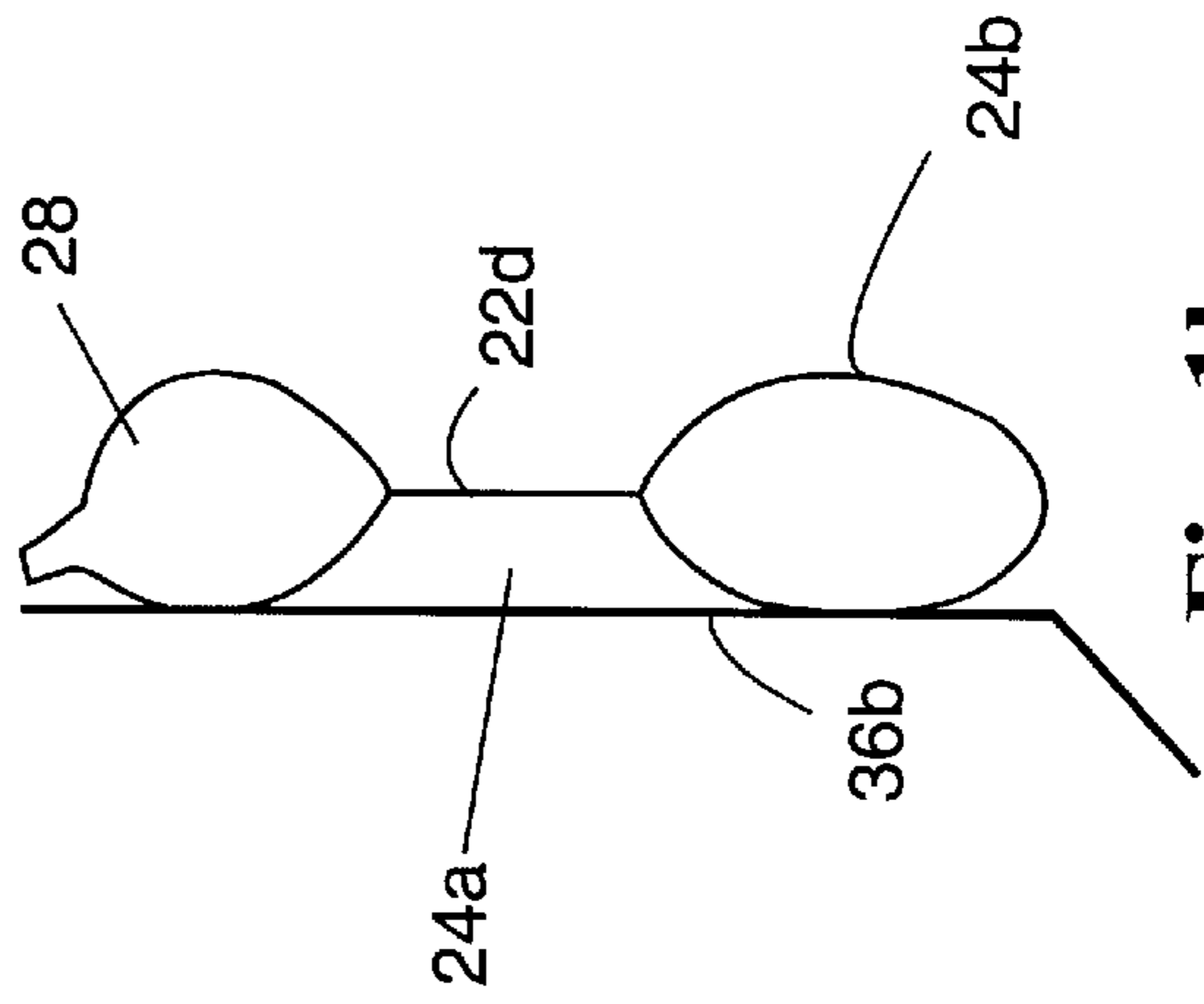




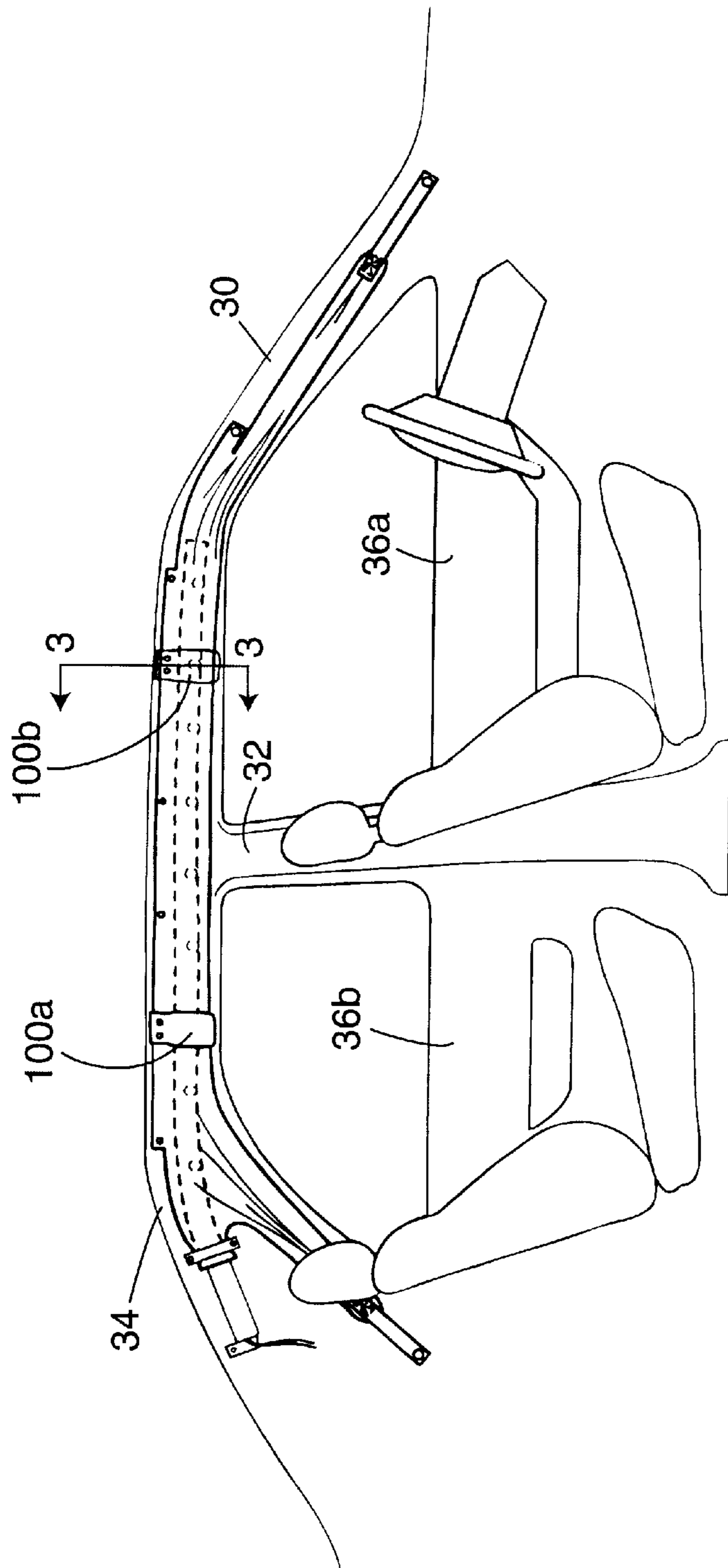
**Fig. 1a**



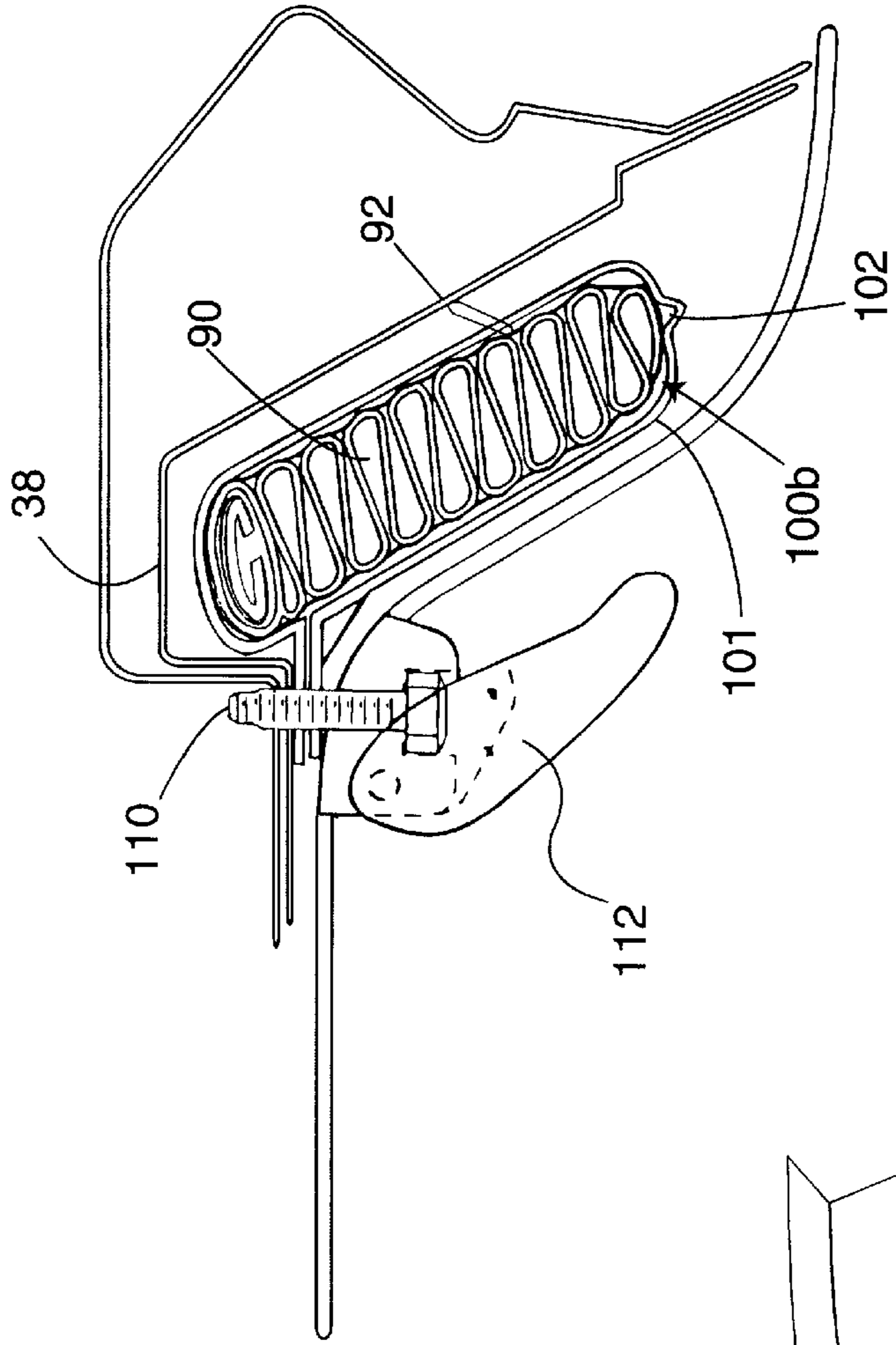
**Fig. 1c**



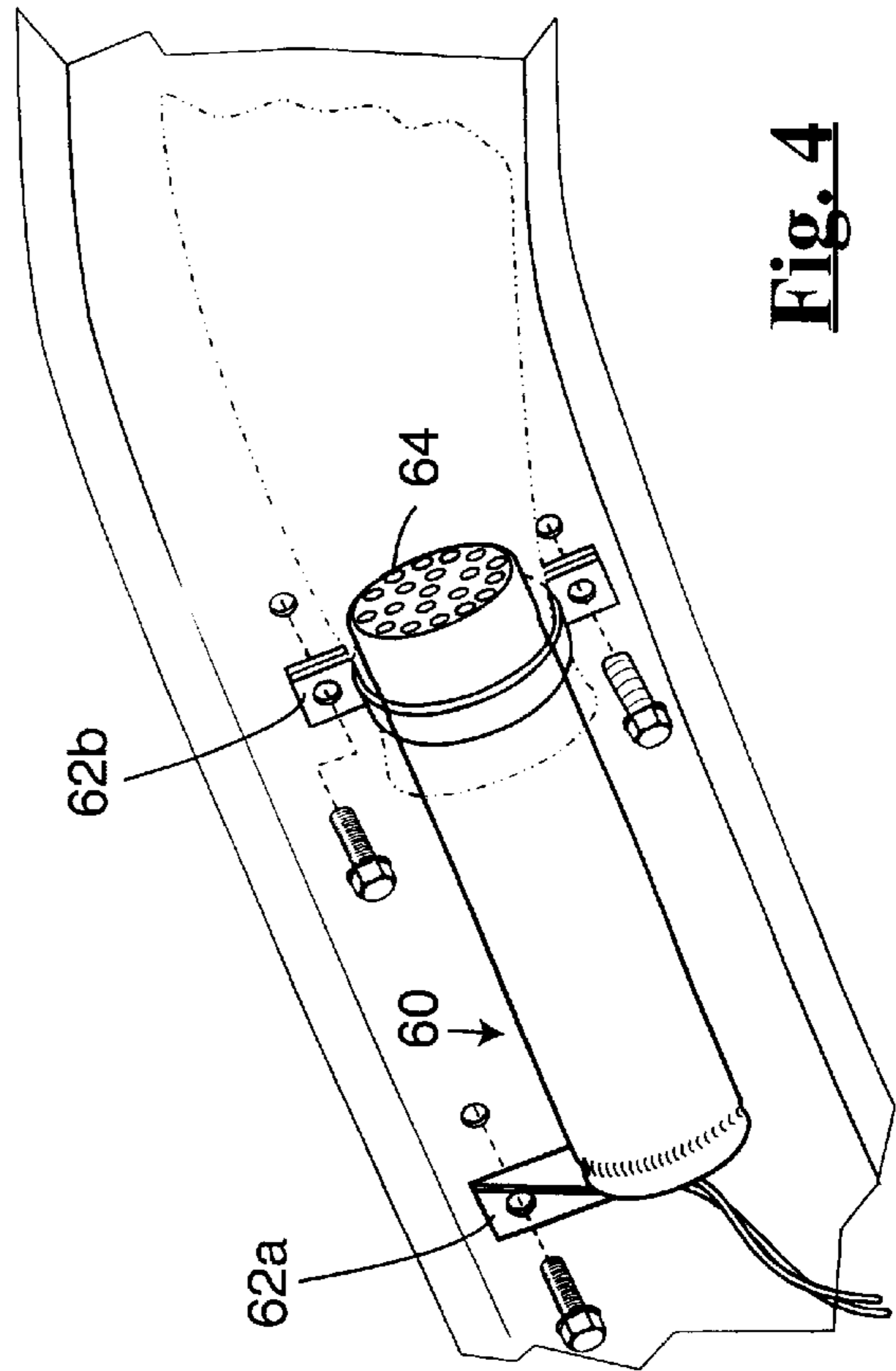
**Fig. 1b**



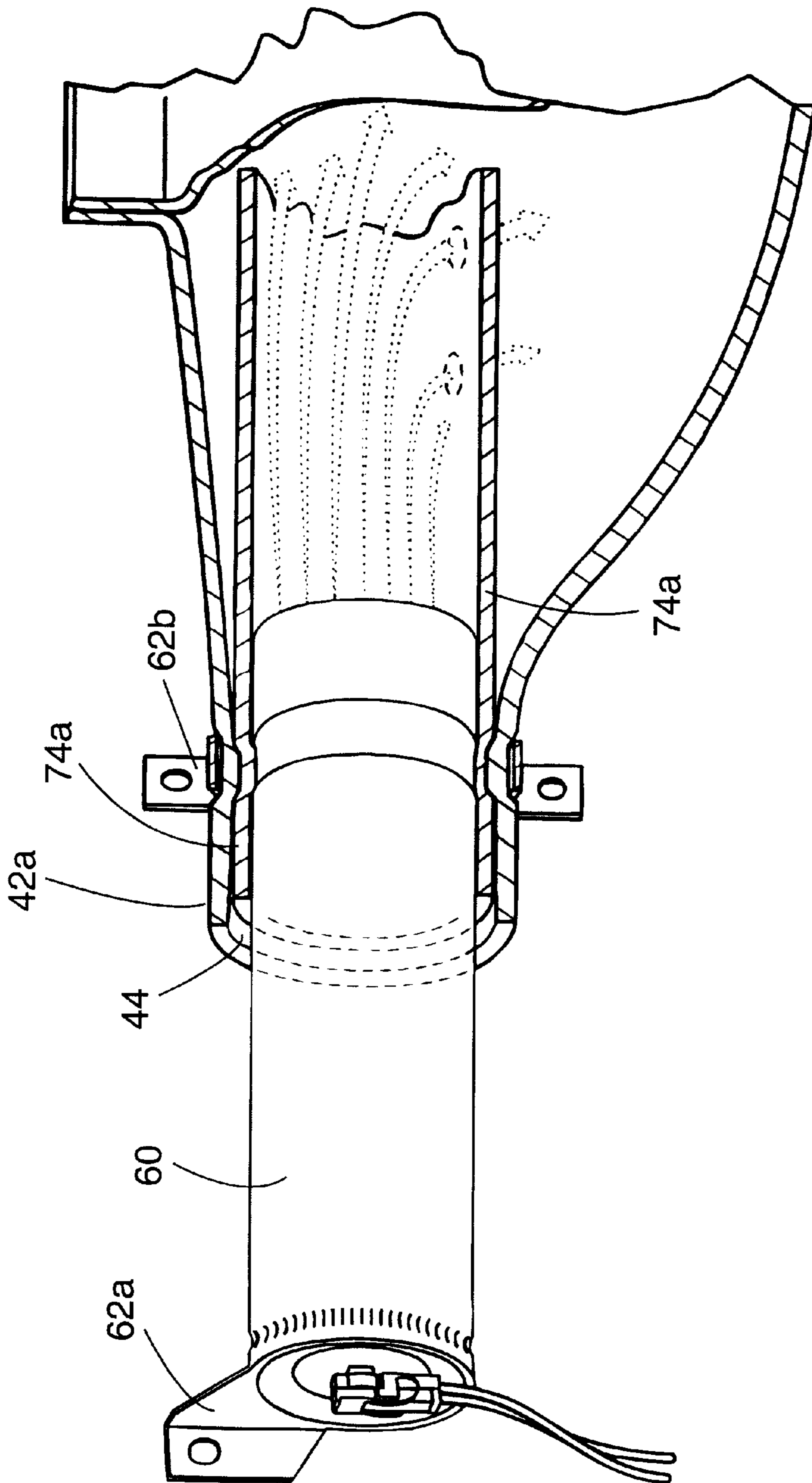
**Fig. 2**



**Fig. 3**



**Fig. 4**



**Fig. 5**



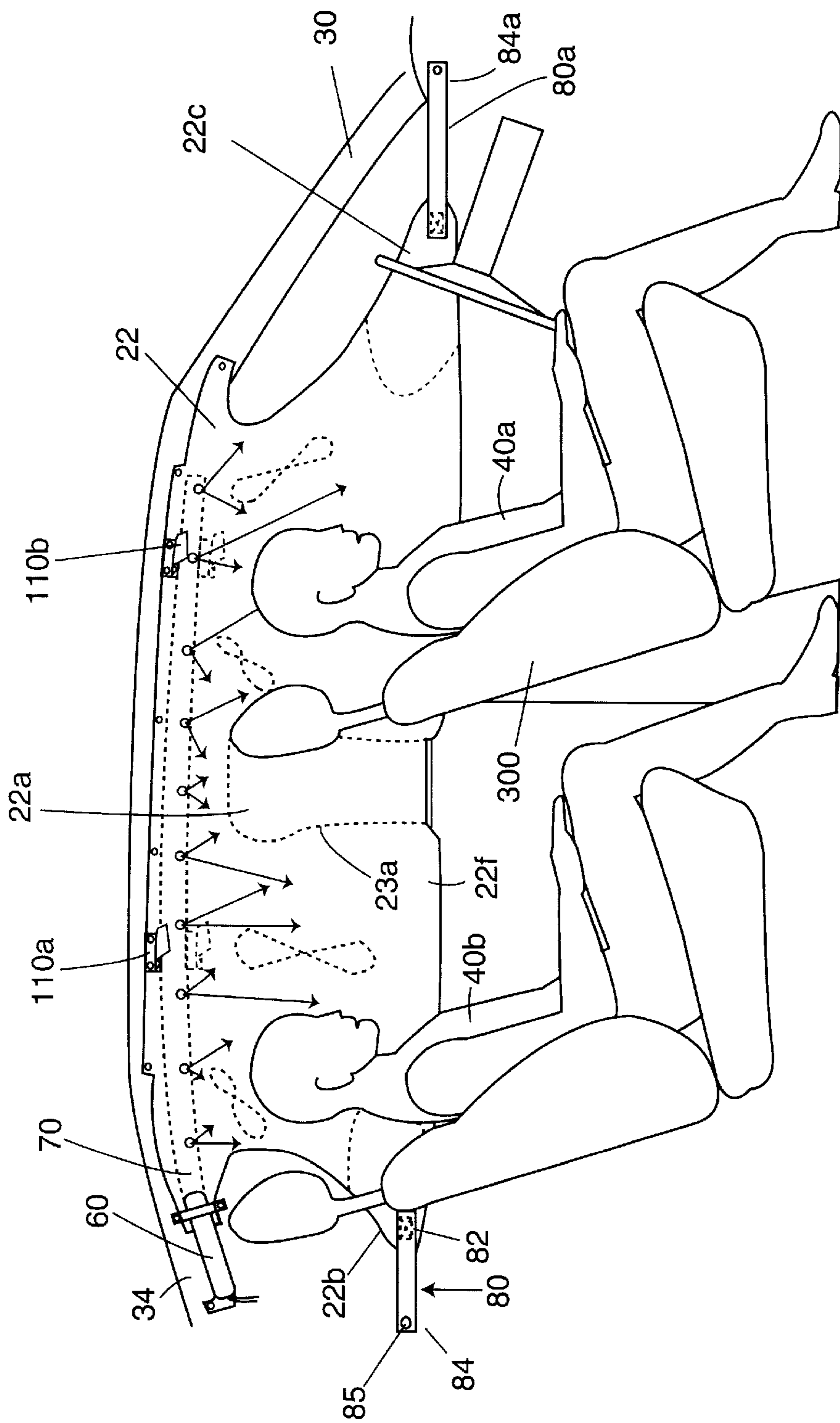
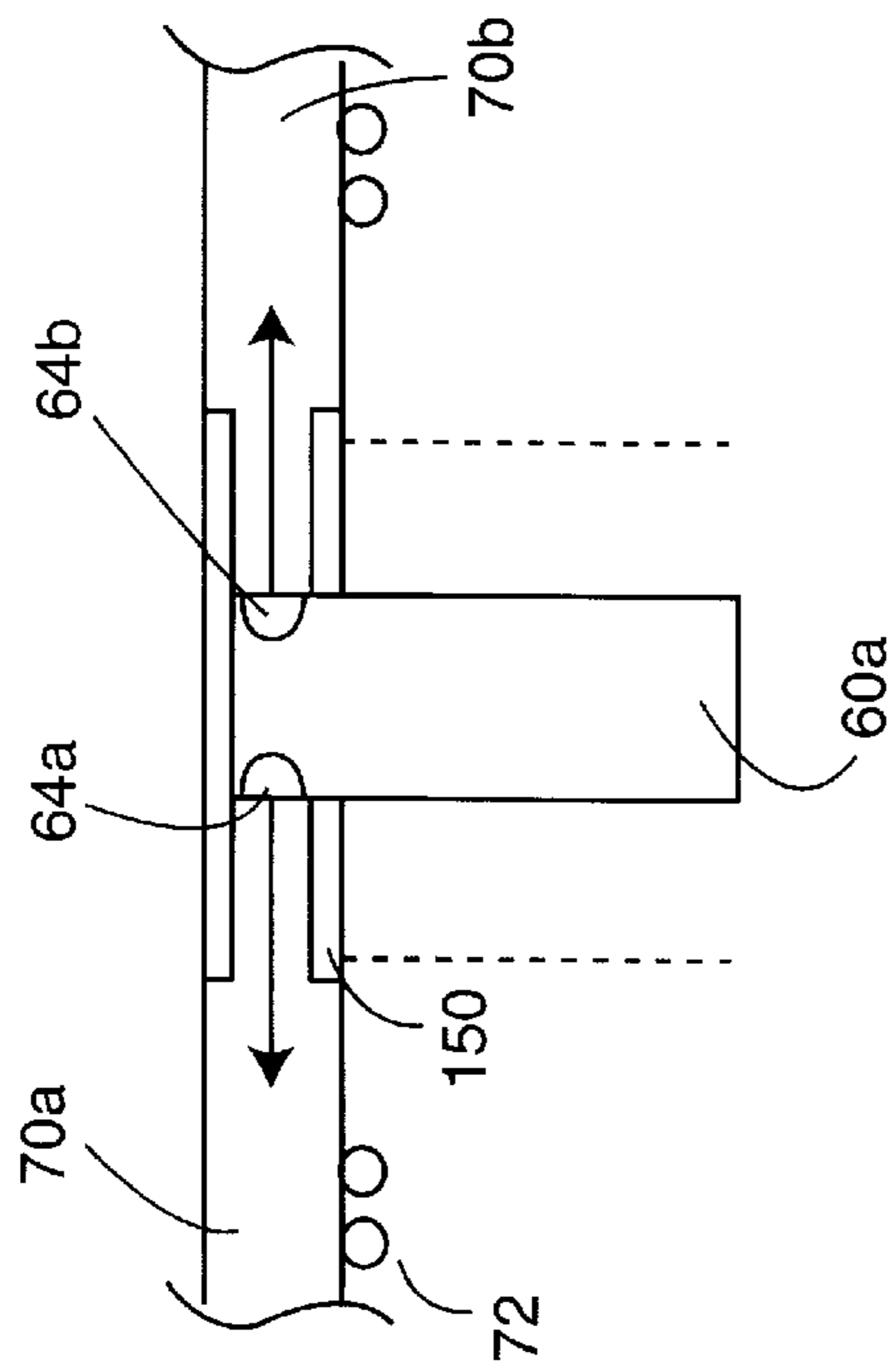
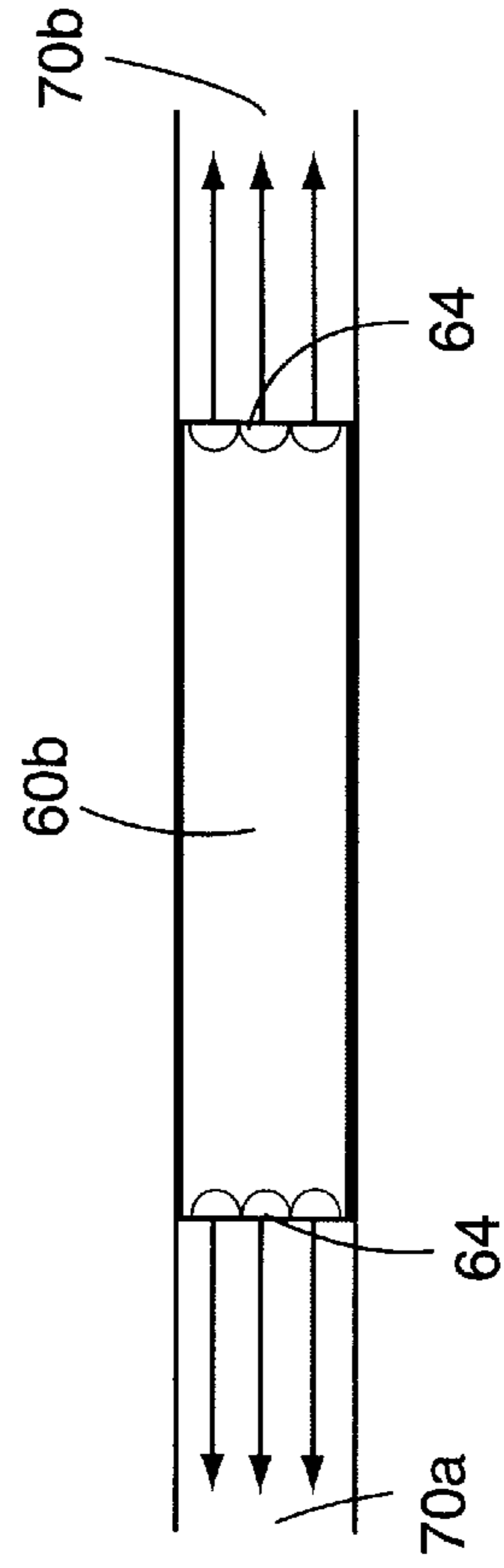


Fig. 6



**Fig. 7**



**Fig. 8**

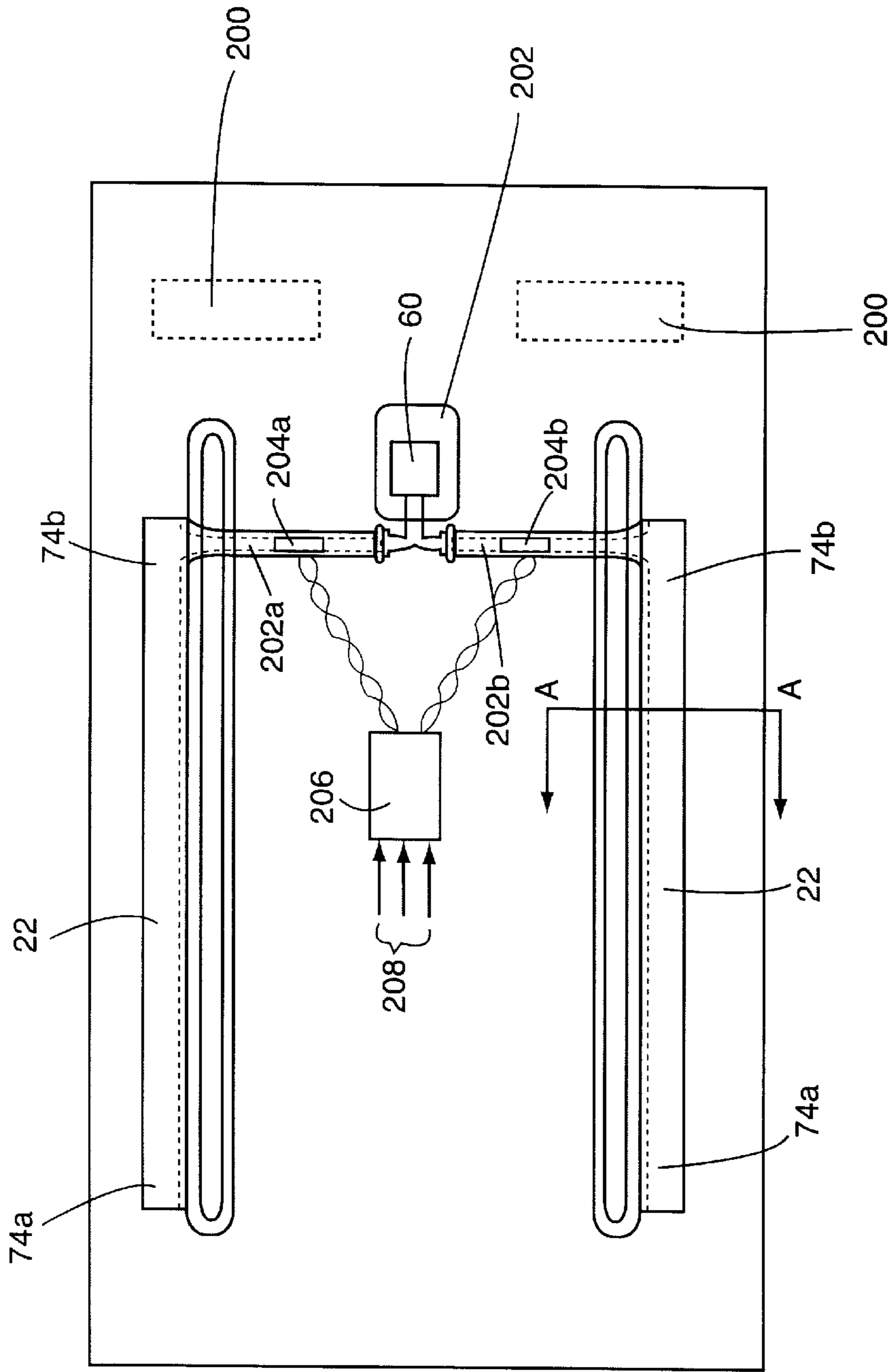


Fig. 9



## INFLATABLE SIDE AIRBAG CURTAIN MODULE

This application is a division of application Ser. No. 09/026,571, filed Feb. 20, 1998 now U.S. Pat. No. 6,073, 961.

### BACKGROUND AND SUMMARY OF THE INVENTION

The present invention relates to an inflatable side curtain (or air bag) airbag module assembly designed to provide occupant protection to vehicle passengers during a side impact (crash or collision) or rollover event. More particularly, the module is mounted proximate the vehicle roof rail and concealed by the headliner trim. Upon impact, the curtain (or air bag) deploys between the occupant and intruding object to protect the outboard front and rear occupants.

Accordingly the invention comprises: a side impact or rollover protection restraint system **20** comprising: an air bag of sufficient length to extend from an A-pillar **30** across a B-pillar **32** and be secured proximate a C-pillar **34** of the vehicle, the air bag **22**, upon inflation, is of sufficient height to extend from proximate a roof rail **38** of the vehicle to a location generally adjacent the upper torso of a seated occupant such that the inflated air bag will lie between the occupant and a side portion of the vehicle; the system **20** further including a flexible tube **70** having a plurality of distributed openings **72** thereacross to distribute inflation gas to the air bag and means (**60**) for inflating the air bag.

It is an object of the present invention to provide an air bag or inflatable curtain to protect one or more vehicle occupants in a side impact or roll over crash event.

Many other objects and purposes of the invention will be clear from the following detailed description of the drawings.

### BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1a** illustrates the major components of the present invention.

FIG. **1b** shows a cross-sectional view taken through a portion of the air bag of FIG. **1**.

FIG. **1c** is a cross-sectional view of a tube.

FIG. **2** is a left-hand plan view of the interior of a passenger compartment showing the major components of the present invention.

FIG. **3** illustrates a cross-sectional view showing the interconnection of an air bag/cushion in relation to a roof rail.

FIG. **4** is an isometric view of an axial flow air bag inflator.

FIG. **5** illustrates the interconnection of the inflator with other components of the invention.

FIG. **6** shows a side curtain or air bag in its deployed state protecting occupants within the passenger compartment.

FIGS. **7** and **8** illustrate alternate embodiment of the invention.

FIG. **9** shows an alternate installation of the present invention.

### DETAILED DESCRIPTION OF THE DRAWINGS

Reference is now made to FIGS. **1a**, **2** and **6**. FIG. **1a** illustrates a side impact/rollover module generally shown as

**20**. The module **20** comprises an air bag **22** of sufficient length to extend generally from the vehicle's A-pillar (see FIG. **2**) **30** across the B-pillar **32** to the C-pillar **34**. The air bag **22** is of sufficient height such that when deployed (as illustrated in FIG. **4**) the air bag **22** will lie between the side panels **36a** and **36b** of the vehicle and the upper torso of the outboard seated occupant, generally shown as **40a** and **40b**.

The air bag **22** comprises a plurality of sewn panels **24a** and **24b** of woven airbag fabric or panels of thermoplastic material that are welded or bonded together. With regard to the fabric, airbag material permeability is chosen to match the required time that the airbag should be inflated. The top **26** of the air bag **22**, proximate a joined seam **28** of the panels **24a** and **b** includes a plurality of openings **40**. A plurality of fasteners, not shown, are used to secure the top **26** of the air bag **22** to the reinforced roof rail **38** (see FIG. **5**). One end, such as the left, rear end **42a** of air bag **22**, includes an opening **44**. Inserted within this opening **44** is an air bag inflator **60** (see FIG. **4**). In the embodiment shown, the inflator **60** includes a plurality of mounting brackets or flanges **62a** and **62b** to permit the inflator **60** to be mounted to an adjacent structural component such as the C-pillar of the vehicle. The inflator **60** may be a solid propellant, hybrid, augmented or liquid inflator of known variety, which upon activation produces or supplies pressurized inflation gas to the air bag **22**. In the embodiment illustrated, the inflator **60** includes a plurality of axially oriented output ports **64**. Located within the top portion **26** of the air bag **22** is a flexible tube generally shown by numeral **70**. In the preferred embodiment of this vehicle, the tube **70** has an elastomeric inner tube **71** with a reinforced outer sheath made of a braided or woven fabric **73**, as shown in FIG. **1c**. Alternatively, the tube can be made of metal, plastic, rubber or nylon. The tube **70** includes a plurality of openings **72** located thereacross. The tube **70** includes ends **74a** and **74b**. As can be seen in FIG. **5**, end **74a** is secured about the inflator **60**, by bracket **62b**, to permit the inflation gasses to flow directly therein. Opposite end **74b** is closed or bonded shut. It should be appreciated that the inflator **60** can be mounted to end **74b** which would require that end **74a** be similarly closed. In addition, as can be appreciated, upon activation of the inflator **60** inflation gasses will be propelled down the tube **70**. Because of the length of the tube **70** the pressure distribution of the inflation gasses will diminish in relation to the distance from inflator **60**. Consequently, the openings **72** in the tube **70** may be non-uniformly distributed along the tube such the entire volume of the air bag **22** is inflated relatively simultaneously. As can be seen in FIG. **1a**, the distribution of openings **72** is biased toward the closed end **74b** of the tube **70**, that is the side of the air bag **22** farthest from the inflator **60**.

As mentioned above, the air bag **22** comprises a plurality of joined panels such as **24a** and **24b**. The center of the air bag, such as **22a**, which lies approximately near the location of the seat back **300**, or alternatively near the D-pillar **32**, is bonded or sewn shut so that it will not be inflated.

The bonding or sew line is shown as **23a**. As can be appreciated, if the air bag **22** were inflated in this location **22a**, it would not provide any measurable degree of occupant protection. The lower left-hand region **22b** of the air bag **22** is similarly bonded or sewn together such that it does not inflate. In addition, this area may be reinforced to enable the connection of a tether **80** thereto. One end of the tether, such as **82**, is bonded or sewn to section **22b** of the air bag while another end **84** of tether **80** is loosely or pivotably secured via a fastener (to a structural portion of the vehicle) which is received through opening **85**. Similarly, the forward



portion **22c** of the air bag **22** is closed so that it does not inflate and a second tether **80a** is secured thereto. Similarly, end **84a** of tether **80a** is secured proximate the lower portion of the A-pillar **30** to permit same to rotate downwardly upon deployment of the air bag **22**. Various other locations, such as **22d** and **22e**, channel the inflation gas to specific inflated lobes or portions of the air bag **22**.

The lower edge of the air bag **22f** is folded upwardly such as into an accordion pleat configuration **90** to achieve the configuration generally shown in FIG. **3**. In this configuration, the air bag **22** of FIG. **1** will essentially be formed into a long, cylindrical-like configuration. To keep the air bag in this rolled configuration, the air bag is enveloped in a breakable or tearable material such as shrink-wrap material (cellophane) **92** of a known variety. The folded, enveloped air bag **22** is then secured to the roof rail **38** using a plurality of retainer clips, such as **100a** and **100b** (see FIG. **2**). As illustrated in FIG. **3**, one of the retainer clips, such as **100b**, includes a pre-stressed tear region **102** to permit each clip to open (as illustrated in FIG. **6**) upon inflation of the air bag **22**. The retainer clips **100a** and **100b** can be secured by fasteners **110**. FIG. **3** shows one such fastener **110** securing clip **100b** to the roof rail.

As is known in the art, many vehicles generally above the front and rear doors, include U-shaped grab handles which are utilized to assist the occupant in egressing the vehicle. One such grab handle **112** is illustrated in FIG. **3**. The fastener, such as **110**, utilized to secure the grab handle to the roof rail can also be utilized to secure the clips **100a** and **b** to the roof rail. As can be appreciated, the number of clips will depend on the individual vehicle. In addition, the folded, enveloped air bag can be placed in a tubular plastic shell having the pre-stressed section **102**; in essence the pre-stressed shell can be envisioned as a plurality of contiguous retaining clips **100a,b**, etc.

Reference is briefly made to FIG. **7** which illustrates an alternate embodiment of the invention. In this embodiment the inflator **60a** is configured such that it comprises at least two exit ports **64a** and **64b** (opposite to one another). The inflator, using an adapter **150**, is secured to opposing sections **70a** and **70d** of a segmented tube **70**. The inflator **60a** of FIG. **7** can be fixedly secured to the B-pillar **32** of the vehicle. FIG. **8** illustrates an alternate embodiment of the invention. In this embodiment, the inflator **60b** comprises axial flow ports **64** at both of its ends. The inflator is connected to opposing sections **70a** and **70b** of the segmented tube **70**.

Reference is briefly made to FIG. **9** which illustrates a further embodiment of the invention. FIG. **9** illustrates a top plan view of a roof of a vehicle. The front windows **200** identify the forward portion of the vehicle. Many vehicles, such as vans and trucks, include a center console **202** located in front of and between the seating locations of the front occupants of the vehicle. Located generally in the area of this console is a central inflator **60** that is communicated via tubes or conduits **202a** and **202b** to a section proximate the closed end **74b** of opposingly situated cushions **22**. The opposing end **74a** of each of the cushions **22** is enclosed. Situated within each conduit **202a** and **b** is a respective control valve **204a** and **204b** which is responsive to signals received from a control unit generally shown as **206**. The control unit is responsive to input signals **208** received from a plurality of crash sensors located in and about the vehicle. Upon sensing that the vehicle is involved in a crash on one or the other side of the vehicle, or that the vehicle is involved in a rollover, toward one or the other side, the controller **206** activates the inflator **60** and one of the corresponding control

valves **204a** or **204b** to permit inflation gas to flow to one or the other of the air bags **22** on the right or left-hand side of the vehicle in the side impact and/or rollover crash event. Alternatively, and depending upon the capacity of the inflator **60** of FIG. **8**, the control unit **206** may simultaneously activate both valves **204a** and **b** which will then deploy both of the air bags **22** on either side of the vehicle such that they achieve the deployed orientation as illustrated in FIG. **6**.

Many changes and modifications in the above-described embodiment of the invention can, of course, be carried out without departing from the scope thereof. Accordingly, that scope is intended to be limited only by the scope of the appended claims.

What is claimed is:

1. A side impact or rollover protection restraint system (**20**) for a vehicle occupant, the vehicle including along a first side thereof a first pillar and a second pillar, the system comprising:

a first air bag of sufficient length to extend from about the position of the first pillar (**30**) across to and secured proximate the second pillar (**34**) of the vehicle, the first air bag (**22**), upon inflation, is of sufficient height to extend from proximate a first roof rail (**38**) on a first side of the vehicle to a location generally adjacent a shoulder of a seated occupant such that the inflated air bag will lie between the occupant and the first side of the vehicle;

the system (**20**) further including a first flexible tube (**70**) having a plurality of distributed openings (**72**) there-across to distribute inflation gas to the first air bag wherein the first flexible tube extends substantially across the length of the air bag and inflation means (**60**) for inflating the air bag.

2. The system as defined in claim 1 wherein the openings are non-uniformly distributed across the length of the first tube such that inflation gas is distributed across the width of the first air bag generally uniformly.

3. The system as defined in claim 1 wherein in a pre-inflation state, the first air bag is folded and encased within a tubular plastic shell, the shell being opened as the first air bag inflates, the shell includes a region having a preferred tear feature.

4. The system as defined in claim 3 wherein the tear feature is located proximate a lower portion of the folded first air bag.

5. The system as defined in claim 1 wherein the inflation means includes at least one exit port coaxially arranged with a longitudinal axis of the tube.

6. The system as defined in claim 1 wherein the tube includes an elastomeric inner tube and a reinforced outer sheath.

7. The system as defined in claim 6 wherein the outer sheath is one of braided and woven material.

8. The system as defined in claim 1 wherein the first air bag is secured to the first roof rail by a break-away clip held to the first roof rail by a fastener and wherein the vehicle also includes a grab handle grasp located near the first roof rail, wherein the same fastener secures both the clip and the grab handle.

9. The system as defined in claim 1 wherein the first tube includes a first and a second portion and wherein the inflation means includes at least two exit ports, a first of the exit ports operatively communicated to the first portion and a second of the exit ports operatively communicated to the second portion.

10. The system as defined in claim 1 wherein the vehicle includes on an opposite side thereof a third pillar and a



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fourth pillar and a second air bag that extends from about the third pillar to about the fourth pillar, and wherein the inflation means is communicated to both the first and to the second air bag.

**11.** The system as defined in claim **10** further including a first control valve means, communicated between the inflation means and the first air bag, for regulating the flow of inflation gas to the first air bag and a second control valve means communicated between the inflation means and the second air bag, for regulating the flow of inflation gas to the second air bag.

**12.** The system as defined in claim **11** wherein the inflation means is located in a forward roof portion of the vehicle.

**13.** A side impact or rollover protection restraint system **(20)** for a vehicle occupant, the vehicle including along a first side thereof a first pillar and a second pillar, the system comprising:

a first air bag of sufficient length to extend from about the position of the first pillar **(30)** across to and secured proximate the second pillar **(34)** of the vehicle, the first air bag **(22)**, upon inflation, is of sufficient height to extend from proximate a first roof rail **(38)** on a first side of the vehicle to a location sufficient to protect a seated occupant such that the inflated air bag will lie between the occupant and the first side of the vehicle; and

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inflation means **(60)** for providing inflation gas to the air bag;

wherein the vehicle includes on an opposite side thereof a third pillar and a fourth pillar and a second air bag that extends from about the third pillar to about the fourth pillar, and second inflation means for providing inflation gas to the second air bag.

**14.** A side impact or rollover protection restraint system **(20)** for a vehicle occupant, the vehicle including along a first side thereof a first pillar and a second pillar, the system comprising:

a first air bag of sufficient length to extend from about the position of the first pillar **(30)** across to and secured proximate the second pillar **(34)** of the vehicle, the first air bag **(22)**, upon inflation, is of sufficient height to extend from proximate a first roof rail **(38)** on a first side of the vehicle to a location sufficient to protect a seated occupant such that the inflated air bag will lie between the occupant and the first side of the vehicle; the system **(20)** further including a first flexible tube **(70)** having a plurality of distributed openings **(72)** thereacross to distribute inflation gas to the first air bag wherein the first flexible tube extends substantially across the length of the air bag and inflation means **(60)** for inflating the air bag.

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